

Metal Infusion Surface Treatment (MIST) Technology Wins R&D 100 award

A cooperative effort between Chemical Composite Coatings International, LLC (C3) and two user centers at the Oak Ridge National Laboratory (ORNL) has led to the development of a new surface treatment, Metal Infusion Surface Treatment (MIST) which results in increased lifetimes and higher performance of engineering components. This technology was recently selected by the independent judging panel and editors of *R&D Magazine* as one of the 100 most technologically significant products introduced into the marketplace in 2006.

The MIST technology can infuse up to 51 elements into the surface of metals and alloys, and then secures these elements with a thin, nanostructured coating. An Industrial Technologies Program (ITP) Metals Processing Laboratory Users (MPLUS) facility project at ORNL discovered a means of bonding the coatings to a substrate without spalling or flaking, using rapid infrared processing. This treatment was applied to parts used in aluminum die casting. The coating improved the life of die casting components from 30 to 50 times, and produced inserts that led to the doubling of spindle speeds with no reduction in tool life. To better understand how the rapid infrared heating process works, X-ray diffraction (XRD) and Scanning Auger Microanalysis (SAM) were used at ORNL's High Temperature Materials Laboratory (HTML) to characterize the coatings in a project sponsored by the FreedomCar and Vehicle Technologies Program. The XRD work defined the structure of the nanometer scale zirconia of the coating, while the SAM analysis provided details of the composition of the coating from the surface to the substrate.

As a result of these investigations, C3's patents were extended to include treatment of aluminum die casts and accessories, and C3 International now supplies coated die components and parts to the U.S. aluminum die casting industry. The MIST process can be performed on site. Metalworking tools and catalytic devices have also been treated resulting increased lifetimes and performance. In tests on cutting tools, MIST has yielded lifetimes 10 times better than conventional coatings, increased production rates and reduction in manufacturing costs.

For more information see http://www.c3intl.net/OakRidgeNat_ILabs-article_ADOBE_ACROBAT.pdf and http://www.ornl.gov/info/press_releases/get_press_release.cfm?ReleaseNumber=mr20060705-00

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Figure 1. Untreated and treated H-13 steel die pins after 3,500 and 200,000 shots of aluminum respectively



Figure 2A. Thermocouple sheaths after being exposed to molten aluminum;
Lower probe is uncoated after 91 cycles.



Figure 2B. MIST coated probe after 467 cycles. Dip tests with molten aluminum (760°C) performed at Pyromation reported a 8 times extension in the life of 1010 steel thermocouple sheaths with the application of six layers of the z-MIST coating solution.